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Article

Learning for Transformation of Water Governance: Reflections on Design from the Climate Change Adaptation and Water Governance (CADWAGO) Project

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Abstract: This paper considers how learning for transformation of water governance in the context of climate change adaptation can be designed for and supported, drawing examples from the international climate change adaptation and water governance project (CADWAGO). The project explicitly set out to design for governance learning in the sense of developing elements of social infrastructure such as workshops, performances and online media to bring stakeholders together and to facilitate co-learning of relevance to governance. CADWAGO drew on a variety of international cases from past and ongoing work of the project partners. It created a forum for dialogue among actors from different contexts working at different levels and scales. The range of opportunities and constraints encountered are discussed, including the principles and practicalities of working with distributed processes of design and leadership of events. A range of concepts, tools and techniques were used to consider and facilitate individual and collective learning processes and outcomes associated with water governance in the context of climate adaptation. Questions were addressed about how elements of past, present and future water governance thinking and practice are connected and how multi-level systemic change in governance can take place. Some reflections on the effectiveness of the design for learning process are included. The nature of the contribution that projects such as CADWAGO can make in learning for transformation of water governance practices is also critically considered.

Keywords: learning; design; water governance; transformation; CADWAGO

1. Introduction

Water governance means different things to different people, depending on whether the act of governing is seen as about guiding, directing, ruling and/or valuing water. Franks and Cleaver, ([1] p. 291) suggest that "*Governance provides a way of conceptualizing [the] emerging network of relationships between different sectors and interests in society enabling us to analyse how governments, the public and private sectors, civil society, citizens groups and individual citizens forge networks and linkages to provide new ways for society to order itself and manage its affairs.*" Their focus on emerging networks and linkages recognises the dynamic nature of governance and its context. Water governance has many different interconnected dimensions, including institutional, political, social, regulatory, economic, administrative and ethical arrangements or systems that are in place, or required, to manage water as a resource and for providing water services [2,3]. In this paper we draw on a range of understandings and on our experiences to consider water governance as a systemic concept with inter-connected multi-level and multi-scale processes of action and interaction that need to take account of how governance-related and biophysical systems affect, or could affect, each other [4,5].

In recent years there has been an increasing focus on water governance and calls for its transformation because existing governance arrangements do not work together well enough to deal with the challenges of sustainable water management in the context of climate change as, for example, increasing extreme weather events have led to floods and droughts [2–7]. It is claimed that the transformations required are to move from existing water governance regimes that lead to unsustainable water management practices to more systemic and adaptive governance regimes [5,6]. Furthermore, literature claims that in order to make such transformations there is a need to build capacity for adaptation to climate change at different levels in society [7,8]. This capacity includes the ability of actors to plan, prepare for, facilitate and implement adaptation options across levels and scales [9], (level here refers to a position within a system hierarchy and scale to dimensions used for measurement or study [5,10]). Although scientists and practitioners widely agree about the need for governance, adaptive capacity, and learning—which have been seen by many as inter-related [11–15]—little is known about how learning processes that could benefit adaptive decision-making and shape resilient livelihoods can be designed and supported [6,13,16]. This paper investigates what happens when ambitions regarding water governance learning are put into practice. It does so mainly through focusing on how to bring about learning of relevance to transformation of water governance where there are diverse stakeholders at different levels and scales. This question is addressed by means of a case study of experiences of the CADWAGO research project.

The CADWAGO project (climate change adaptation and water governance, with the aim of reconciling food security, renewable energy and the provision of multiple ecosystem services) was a project led by the Stockholm Environment Institute [7]. In terms of 'governance learning' it focused largely on social learning that led, or could lead, to concerted actions to improve water governance across levels and scales [5,10,12,16–19]. From 2013 to 2016 CADWAGO brought together 10 partners from Europe, Australasia and North America with the aim of improving water governance. It created a forum for dialogue between actors from different contexts who work on transforming water governance at different levels and scales. Events throughout the project provided a space for shared understanding between those in research, policy, the private sector, and local contexts to explore how they work within the messy context of multiple water management dilemmas (e.g., managing catchments where there are conflicts among stakeholders in conditions of floods and drought, or where local water resource management institutions well outside of Europe are adversely affected by European policy, or where issues of nitrate and phosphate pollution have widespread systemic effects that are difficult to address at one level). The project was structured around four 'work packages' (WPs): ecological components of ecosystems, climate change adaptability in water governance institutions and organisations, systemic governance practices, and governance learning.

Figure 1 shows how three of the work packages applied their theoretical lens (inner circle) to a set of case studies (oval below) to reflect on natural resource management (NRM) dilemmas where

water was central in a diverse set of national and transnational contexts. These lenses enabled the development of a cross-case narrative describing the orchestration of a diverse set of governance performances (second circle). The dialectic between the cross case narratives and co-learners of European water dilemmas was facilitated by CADWAGO's fourth (governance learning) work package (third circle). The emergent governance learning enabled conceptual, institutional and practice innovations to support systemic and adaptive water governance in Europe (outer circle).

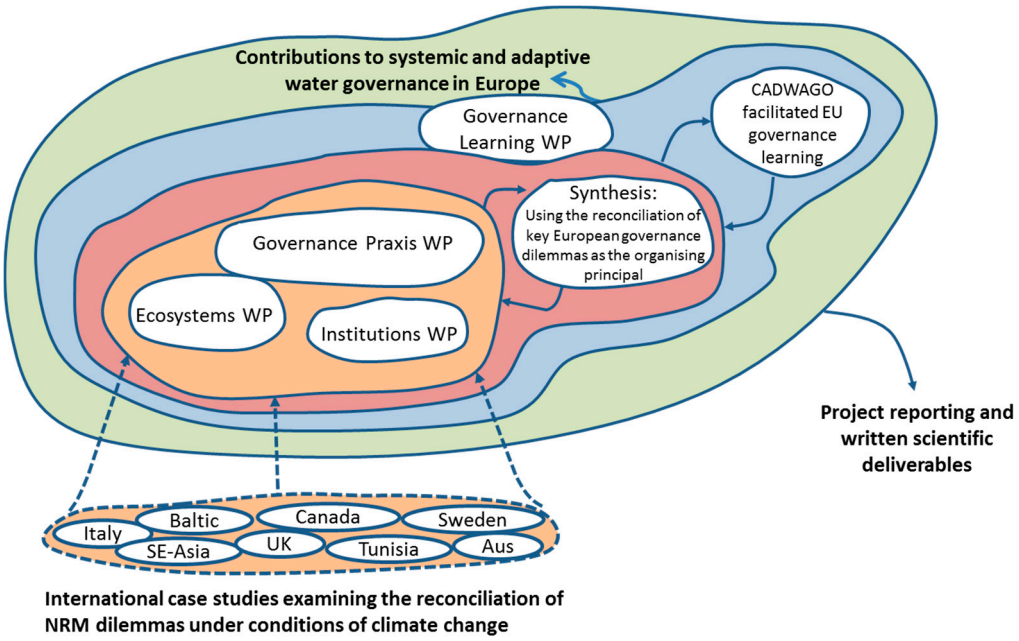

Figure 1. The climate change adaptation and water governance project (CADWAGO) research process. (Source: [7]) WP: 'work packages'.

This paper is largely about the governance learning work package which was conceptualized at a meta-level in the project, both informing and being informed by the other three work packages. It contributes to a growing area of literature on how co-production of knowledge processes in the context of environmental governance work in practice and how they can be supported [5,20–25].

2. Methods

2.1. Research Focus and Overall Approach

Initially, CADWAGO set out to consider three research questions, namely:

1. What changes are needed in the existing conceptualisation and framing of different modes of water governance to enable systemic and adaptive responses to climate change?
2. What are the social and institutional barriers and opportunities for adaptive and systemic responses to climate change within existing water governance regimes?
3. What practices and processes are necessary to foster systemic and adaptive responses within water governance? Source: [7].

Learning was implicit rather than explicit in these three questions but the idea of learning to improve governance was seen as central to CADWAGO. The project's conceptual frameworks (both at whole project and work packages levels), methodology and key areas of expertise of project staff all included learning. The focus on learning increased at the project's inception meeting, where a conceptualization of change and governance learning as an interactive co-production process was elaborated alongside the framings of the other work packages. It became apparent that a fourth work

package (WP4) would be desirable to work at a meta project level. WP4 would focus on governance learning by facilitating the learning and communication processes required to enhance learning within the project and to extend CADWAGO's learning relating to governance beyond the project staff to the wider European water governance environment. WP4's aims were to develop understanding of how co-production of knowledge processes work in practice and how they can be supported by (i) designing and operationalizing an enabling environment for co-production of knowledge processes to emerge; (ii) analysing these processes and reflecting on them; and (iii) using these findings to contribute to increased governance learning which can help to bring about desirable change in the European water governance domain.

The methodological approach of the CADWAGO governance learning work package can be described as abductive in that it was qualitative and constructionist and sought to explicate what was experienced by participants in situations of complexity rather than to explain an objective world [26,27]. Several traditions of understanding underpinned this approach, including systems thinking in practice, communities of practice, social learning and action research. The significance of each of these traditions will be explained later in this paper. The design processes of governance learning activity that took place as part of the CADWAGO project could be considered as methods in the context of this abductive approach. These processes were planned, systematic and reflexive. They were also systemic because they were informed by systems thinking which acknowledges interconnections and considers elements and processes in context, in order to consider a whole system of interest rather than just its parts.

2.2. Role of Researchers in the Design Process

Ison et al. [28] make a distinction between first- and second-order design of learning systems, which aligns with first and second-order cybernetic theoretical traditions. First-order design refers to an objective process which considers control as possible and uses 'blueprint' (reproduction) thinking. Second-order design takes more account of context and also includes consideration of the designer and their history in the design process. CADWAGO aimed to use a second-order approach to design for learning which had many implications for the role of the researchers and the methods used. Different theories of learning draw out different concepts and principles [17,24]. Learning underpinned by social constructionist and cybernetic traditions that emphasise the social construction of knowledge and communication and learning processes are in stark contrast to more linear instructivist traditions. Design for learning in the former traditions focuses on facilitation, co-production of knowledge and feedback whereas the latter focuses on content, knowledge transfer and teaching. While these different approaches have both strengths and limitations in different contexts, a systemic, learning process and constructivist approach has proved to be useful when dealing with competing claims on water, in a context of complexity and uncertainty and is consistent with the adaptive capacity building discussed in our introduction [11–16,29,30].

CADWAGO researchers needed to understand how and when to: encourage interaction among participants, appreciate and draw on multiple perspectives, develop joint contributions, use methods that encouraged divergence and convergence, and work with differences and commonalities. As they were working in a co-learning situation and were themselves stakeholders, they also had to take account of their own perspectives in the processes. The systemic nature of the design also required skills, tools and techniques that would facilitate the group in making interconnections, renegotiating boundaries, recognising multiple cause and non-linear dynamics, multiple levels and emergent properties.

2.3. Design for Governance Learning

There were different types of design activity associated with governance learning that were led by the CADWAGO project. Face to face interactions included international governance learning events and national-level 'interim events'. Online media were also used to enable engagement with project activities and interpretation of data that emerged through the project. Below, the governance

learning processes are described, and the rationale for them discussed. All are included to give an overview, though most detail is provided here about the international governance learning events. The achievements, challenges and opportunities of these activities are critically reviewed in subsequent sections of this paper. The thinking behind their design is detailed in the discussion section.

2.3.1. Design of Governance Learning Events

Three international governance learning events and a series of national-level 'interim events' all included elements of design, and following Wenger [31], could be considered a part of the social infrastructure that fosters governance learning.

Three European water governance learning events were a part of the initial project design, hosted by CADWAGO researchers in Sweden, the UK and Italy. Key design principles for all three events were:

- **Principle 1:** participatory design for learning to enable multiple perspectives on relevant issues to be understood
- **Principle 2:** building on the lessons from the past, including an already substantial body of research cases and governance praxis undertaken by partners to create a forum and dialogue among researchers and stakeholders at different levels and scales
- **Principle 3:** designing an enabling environment for co-production of knowledge to emerge.

Table 1 shows the range of core concepts used in the design of each event and tools and techniques that were used to facilitate co-learning. The rationale for the choice of concepts is explained in the specific event-related sections of this paper that follow the table and their usefulness is considered in the results section.

Table 1. Concepts and tools used in the Governance Learning events.

Event No.	Concepts for Framing Activity	Tools and Techniques for Enabling Co-Learning
Event 1	trajectories practices narratives inspiration negotiation	'speed-dating' posters and carousel process conversation mapping presentations critical review
Event 2	systems thinking in practice modelling negotiating evaluating	conversation mapping theme analysis formulations of systems of interest conceptual activity models
Event 3	performance showcasing interacting social learning individual and concerted actions	concert presentations posters *'La Rasgioni'* feedback to local stakeholders–directly and after reflection

The events throughout CADWAGO brought together people from different contexts. In event 1 in Sweden in total 10 external participants joined researchers from the project. In the second event in UK 15 people joined and in the third event in Italy 20 people. Overall one external person joined all three events and five people joined two events.

The process of invitation to the learning events was iterative, recognising the range of different sectors, interests and practices involved in water governance. Invitations were sent to people in the host country as well as to participants from previous events, though other commitments sometimes meant they were unable to attend. One criterion used in identifying participants in order to maximise the potential impact of the project was to involve and support those who appeared to have maximum potential to transform water governance in the context of climate change adaptation. By this we mean those in key positions at different levels who could work with and influence others, who from their

own experiences were already convinced of the need for water governance transformation. These were also largely people who in the view of the researchers appeared to be (or were becoming) concerned with developing adaptive capacity at different levels or scales which tended to be those who were either already creating new narratives regarding European policy, water governance and climate adaptation or who might have an interest in doing so.

(i) Governance Learning Event 1: Sweden

The first annual international governance learning event was held in Uppsala, Sweden in June 2013. Its aims included developing understanding of contemporary issues and European policy of relevance to water governance in the context of climate change adaptation; building relationships with some of those involved in water policy and governance at different levels who might be open to a co-learning process and reviewing CADWAGO's plans and how the project might best support water governance learning. Key concepts used in the design of this workshop were: trajectories, practices, narratives, inspiration and negotiation.

Principles of developing communities of practice were used, including the notion of ***trajectories***. Wenger [31] uses the idea of trajectories to " . . . *provide a context in which to determine what, among all the things that are potentially significant, actually becomes significant learning. A sense of trajectory gives us ways of sorting out what matters and what does not, what contributes to our identity and what remains marginal"* (ibid. p.155). He also comments that "*... as we go through a succession of forms of participation our identities form trajectories... [bringing] a coherence through time that connects the past, the present and the future"* (ibid. p. 154).

The sessions of this event had past, present and future focuses and the day as a whole was intended to connect these focuses as trajectories of relevance to CADWAGO and European water policy. Session 1 in the event focussed on exploring 'the past', specifically participants' contexts and prior experiences. Following a short 'speed dating' exercise in which each person found out about the interests of three others, there was a 'Carousel' process in which small groups of participants visited and discussed CADWAGO posters placed around the room. This was followed by a conversation mapping exercise where roles, interests, hopes and expectations in relation to the project were discussed and recorded.

Session 2 was about the present, highlighting ***practices***, a meaningful concept to most participants, including researchers who had been influenced by the ideas of communities of practice and practice-based approaches to learning developed by Wenger and his colleagues e.g., [31–33]. Currently emerging ***narratives*** were told to provide ***inspiration***. Narratives and storytelling became a part of the learning process from this first event because they were seen as accessible to academics and non-academics alike. Creating the conditions in which people were able to tell their stories and others were able to listen to them was a key part of the design for learning. Project participants presented examples of communities, groups and individuals who had demonstrated self-organisation, capacity building, co-operation and concerted action in relation to water policies and practices. These examples ranged from small lakeside communities in Sweden seeking to develop new relationships for managing issues of conflicting uses of water with a range of different stakeholders, to a large-scale government-led project in the UK prompted by the Water Framework Directive which was largely hard-science driven but where there had been experimentation in bringing different stakeholders together to address emerging issues in novel ways. All non-project workshop participants presented something of the projects that they were working on. An example of a narrative that some project participants included was the biophysical, scientific and sustainability narrative of planetary boundaries [10,34]. The third session focussed on the future. ***Negotiation*** was recognized here in that CADWAGO was about making purposeful changes in water policies and practices for the long term and that we need to move forward in a spirit of working in a constructive way with both our commonalities and differences, i.e., not just where we readily agree. Some co-creation of new trajectories for water policy and governance was explored. All work package leaders gave a short overview of some of the issues that they were

struggling with, requesting feedback from participants. The day ended with a critical review of CADWAGO's plans and future opportunities for co-learning.

(ii) Governance Learning Event 2: UK

This event, held in June 2014 in London, aimed to engage participants in a "co-inquiry" that was consistent with the overall conceptualisation of the work package as co-production of knowledge. The aim was to draw on the perspectives of all participants to consider themes of mutual interest arising across Europe in the context of water policy and governance under conditions of climate change.

Sharing early findings from the CADWAGO project was not privileged but included as part of the process of drawing on perspectives of all participants. A strong influencing factor in this workshop, because of its London location and many UK participants, was the ongoing CADWAGO UK case study concerned with the evolution of a catchment-based approach to water governance. Around 30 people participated in the workshop including academics, consultants, environmental NGOs, and people working for the UK government.

Key concepts used in the design of this workshop were systems thinking, modelling, negotiating and evaluating. The event started with exploring contexts in small groups, using conversation mapping that continued, within time constraints, until all of the participants' responses to an initial question about their experiences of water governance had been discussed and recorded on the conversation map [35]. This encouraged ***systems thinking*** i.e., considering a situation in terms of wholes and relationships rather than as a pre-defined problem or splitting it down to parts to be considered in isolation. This way of thinking acknowledges interconnections, multiple perspectives and multiple causation and looks out for unintended consequences of possible actions [36,37].

Building on the conversation maps, further ***modelling*** was then undertaken to work on what were considered the most important issues, drawing on soft systems methodology (SSM) [38] to work out what was and was not included in participants' systems of interest and to develop conceptual activity models on how to go forward. An example of a system of interest was a system to institutionalise opportunities (social capital) arising from water crises. In the tradition of SSM the process of comparing ideal models and the real-world situation identified both commonalities and differences with significant implications, in terms of taking actions-to-improve the situation. These actions related to a more pro-active, collaborative approach to water governance which takes into account the many different types of knowledge and experiences of those involved [39,40]. A more organised system of monitoring and evaluation was implied, which recognises the multiple benefits arising from the system such as improvements in human well-being and shared responsibilities, not just economic cost savings or improvements in ecological water quality.

As with the Swedish event, ***negotiating*** was a part of the process of groups reaching a consensus on what actions would be both desirable and feasible e.g., in agreeing intended outcomes. There was recognition in the process of modelling of the need for monitoring and ***evaluating***. This was in addition to the evaluation sessions held at the end of each workshop that are detailed in the results section of this paper.

(iii) Governance Learning Event 3: Italy

This event, held in October 2015 in Sassari, Italy, aimed to: showcase and discuss project findings and insights; enable contributions from wider stakeholders; participate in a visit to the Italian case study; engage in co-learning processes; enable critical reflections on our collective learning and to formulate actions for transforming water governance in our different contexts [41]. It brought together researchers from the project as well as practitioners from across Europe who work on transformations of water governance. In total 35 people participated.

In line with the two previous governance learning events this workshop provided a place for participants to draw on the perspectives of a range of people from different backgrounds all working in water policy and governance under conditions of climate change. The workshop was run again

as a co-inquiry, not privileging any one perspective over another. It was designed to facilitate active engagement using a mixture of small group discussions and plenary sessions and included a small number of presentations, a poster session, a visit to the case study area (an intensive dairy cattle system), and a traditional reconciliation event known as *'La Rasgioni'* [42]. Throughout the workshop participants were asked to reflect critically on what they had learnt during this event as well as throughout the entire CADWAGO project.

The key concepts that guided the design of this event were performance, showcasing, interacting, social learning, individual and concerted actions. These concepts were appropriate because of the action research nature of much of the work done, that the project was approaching its end and the local context. The hosts at University of Sassari had over many years developed a tradition of using musical and theatre performances to enable social learning about issues of water management and governance in the context of climate change [43–45]. Initially theatre events had been used as a way of engaging a whole catchment community in a learning process around the complexity of the relationships between farming, society and nitrate water pollution [43]. Inspired by the context of CADWAGO and as a starting point for this event, a concert ***performance*** "*MusicAcqua*: musical variations on climate", composed by Sante Maurizi, was made by the local Youth Orchestra of Sardinia and Youth choir [46]. Following a morning of ***showcasing*** project findings and discussion, a second performance took place as part of the visit to the case study. Two groups of local stakeholders with support from the University researchers, ***interacted*** through presenting their cases to an acting judge and a jury which included the CADWAGO participants [47]. The notions of performance and ***social learning*** in the event as a whole were considered as an emergent property of a number of interrelated elements, including the contributions of many individuals working together, [16,48]. Social learning can refer to individual learning in a social context, to individual learning that has collective outcomes or to learning that has both collective processes and outcomes [49]. *La Rasgioni* drew out the importance of the collective dimensions that led to ***concerted actions***.

(iv) 'Interim' Learning Events

In addition to the three international-level governance learning events a series of further learning events, were held in 2015 to better understand water governance situations and how they might be improved in practice. The idea of these 'interim' events was also to keep up the momentum of governance learning associated with the project between the annual governance learning events. Three events took place in Sweden, organised with other projects that had complementary agendas to CADWAGO and three events in the UK. In Sweden, one was held with the Baltic University Program Secretariat and Uppsala Centre for Sustainable Development (CSD) that examined how different riparian countries conceptualize sustainable development. Another collaborative event took place with the ReSolve project, a multi-stakeholder project tackling sustainability challenges that proposed innovative solutions to Uppsala's storm water problem. The third event was co-designed with the Miracle project that looks at new configurations for governance to reduce nutrient enrichment and flood risks in the Baltic Sea region. On this occasion the event in Kristianstad was a learning exchange between Sweden and Australia on flood management. In the UK two workshops were held to engage researchers, policy-makers and practitioners in a systemic co-inquiry that considered current and future water governance in England. The third event was a symposium held at the Royal Society, London, which showcased CADWAGO research and innovation in water governance and developed an agenda for transforming water governance. All these events were designed for learning using many of the same concepts for framing activities and tools and techniques to enable co-learning that were used in the annual events. Their scope extends beyond this paper and they are documented elsewhere [39,40,50–52] but some of the lessons learnt from designing and participating in them are included in the discussion section of this paper.

2.3.2. Online Media

Online communication among researchers and other co-learners included a project website (www.cadwago.net). This was developed as a resource for people around the world working on CADWAGO-related activity, for engaging with external audiences and as a platform for supporting internal conversation. This site was designed to provide easy access to details of ongoing and forthcoming activity and resources such as publications related to CADWAGO. The CADWAGO blog was an important part of this platform aiming to engage with external audiences and develop a community of interest. Twitter was also used (#cadwago) and a newsletter was sent out regularly There were several iterations in use of online tools and some experimentation with synchronous online events, using tools such as skype. Online events alongside project meetings and the governance learning events were also trialled, with the intention of extending the opportunities for learning both to a wider group of stakeholders than were able to physically attend events and to draw in broader perspectives to the face-to-face events.

3. Results

We set out in this paper to address the question of how learning processes of relevance to water governance transformation can be designed and supported, where there are diverse stakeholders at different levels. Overall, it was found that different perspectives on water governance could be brought together through the designed and emergent event processes described, which were in part an outcome of the modification of the project design that gave increased explicit emphasis to learning and was also supported by the online media. Working with multiple perspectives through the project enabled systemic views to emerge from multi-level (e.g., institutional, organisational, programmes and projects) and multi-scale (e.g., national, whole catchment, local) perspectives of what needed to change, why, how and who to involve.

3.1. Outcomes from the Governance Learning Events

Various results emerged in the process of the governance learning events:

(i) Event 1—The Swedish Event

Following a series of individual presentations from invited and project-based participants a wide range of issues were discussed together using the project's work-package based research 'lenses'. These issues included mosquito management relating to flooding, drinking water health-related issues, water quality in lakes, the legislation and practices of catchment-based approaches prompted by the water framework directive. Acknowledging interconnections and sharing insights enabled the group to consider how to create processes of change that could lead to systemic and adaptive responses. In evaluating the event, participants expressed surprise at a range of issues including the similarities across EU/Sweden and Canada, that participation and quality and quantity of conversations had exceeded expectations that actions were already being taken at many different levels and that some of the themes that emerged had not been expected. Reflections were about process (e.g., that flexibility with discussions and processes during the event can better capture everyone's experiences) outcomes (e.g., "the event gave me energy and inspirations to continue the work with 'my lake and water'") and suggestions (e.g., "great event, but more time to exchange experiences among each other needed").

(ii) Event 2—The UK Event

The following themes were identified by participants in their group discussions:

- roles and responsibilities in changing dynamic of water governance;
- breaking-out of silos and governance structures;
- mismatch between expectations of new processes and the outcomes;

- water crises as opportunities for governance change;
- knowing and learning about water and its purpose; and
- planning under conditions of uncertainty.

These themes were brought together in plenary in a discussion of what concerted actions are needed to improve water governance. One example was to value and build on social capital arising from water crises. The necessary action was identified as more pro-active and collaborative governance arrangements. In evaluating the event participants reported that the workshop had provided new networks, perspectives, ideas, insights, skills, techniques, opportunities, commonalities and differences in water governance and emergent thinking and outcomes. Comments on potential improvements to the workshop were about structures and processes (e.g., more time or better closure of specific sessions) and increasing the range of stakeholder involvement [40].

(iii) Event 3—The Italian Event

In this final event in Italy, an agenda was developed together for collective as well as individual actions. These actions ranged from drawing on different perspectives in activities such as building stakeholding in catchment based approaches for water governance, to collaborating across existing water governance and sustainability focused projects, to developing a related PhD course and sharing methodological skills such as co-inquiry, social learning, and gaming skills. Key insights that arose in participants' evaluation of the event included comments on the success of the tools used in generating interaction, and suggestions for further explorations that included linking legislative initiatives; sharing research questions and evaluations of methodologies, including learning events; writing up findings; building on the event beyond the project, including through other projects; and use of a web-forum. Other comments mentioned that the event had achieved better understanding of the many facets of water and the importance of starting with dialogue at a local level. Key points of learning were about methods used, complexity, enjoyment, communication, participants, trust and future challenges including how to take various action points forward [41].

(iv) Interim Events

Agendas for action were also developed in the interim events which are documented elsewhere [39,50–52]. Feedback from participants in the interim events was almost all positive with comments on similar topics to the other events and a strong experiential dimension e.g., in the learning exchange between Sweden and Australia regarding emergency response and in hearing what had prompted innovations at international, national and local levels. The ways in which these event outcomes and others from the project relate to water governance transformation and climate change adaptation is considered further in the discussion section. Overall, evaluative comments on the processes of the events and suggestions for improving them were particularly relevant to design for learning.

3.2. Outcomes of Online Activities

The project website evolved over the course of the project to become a useful resource for those who had participated in the project and others, as recognised from feedback on the website to the project manager and the level of usage of the site. It includes details of the research approach, the cases, publications, videos, what happened at events, a blog and an internal forum. The resources provide potential for further learning by others. The role of the Project Manager in designing, moderating and ensuring support for online activity was found to be essential. The online elements that were used to extend the face-to-face governance learning events ranged from informal conversations by skype, particularly with CADWAGO researchers in Australia and Canada, to more formal sessions that used a range of media (video, podcasts, skype, phone) that were part of the events e.g., in the London-based interim event at the Royal Society. All the online elements were found to be useful to

some participants but had limitations due for instance to the technology available, level of motivation and to the degree of integration with 'face-to-face' elements. For the purpose of reporting findings, when the technology worked well the use of online media was successful. However, the event processes were often quite complex with small group work and diagramming taking place rather than general discussions and reporting, so it was not always feasible to involve wider stakeholders through online media synchronously. Online follow-up to events did reach the wider interested audience. It should also be noted that not all of the online activities that the researchers aspired to and planned came to fruition. This was due to a range of factors, including that researchers capacity and enthusiasm to engage through online means was often limited and time differences across Europe, Canada and Australia were challenging.

3.3. Findings on Researchers' Roles and Experiences

There were also results to report concerning the role of the researchers in the design for learning process. Design and leadership of the events were by necessity quite distributed among those responsible for WP4 and more local project staff who had important long-term working relationships with many of the participants. Bennet et al. [53] in their review of the literature on distributed leadership noted a range of definitions. In considering the nature of the distribution of design and leadership of the CADWAGO events, we follow the work of Gronn who defined leadership as "emergent work-related influence" ([54] p. 659) and distributed leadership as (i) aggregated leadership behaviour which is dispersed rather than concentrated and (ii) as concertive action, in which distributed leadership is more than the sum of its parts ([54] p. 679).

It was found that a design for learning process in the context of past and on-going case studies needed to take account of the nature of different stakeholdings and positions if it were to become concertive (or *concerted* as we more commonly referred to it in the CADWAGO project building on the metaphor of a concert performance) action adding up to more rather than less than the sum of its parts. Some participants inevitably had more at stake than others e.g., regarding livelihoods, ongoing research and needs for change. There were therefore elements of co-design where a range of stakeholders were actively involved, mostly alongside the core WP4 team, in the design process for the events.

The distribution of design and leadership for the events was found to be quite challenging by some of the researchers who in previous event design processes had become used to having more autonomy. Many agreements had to be reached, for instance, on who was inviting, making logistical arrangements, setting up venues, facilitating individual sessions, writing reports and following up actions identified. Focussing on WP4 as an activity to be carried out by whoever was most appropriate (and available) to do it and not WP4 as a research team was found to be helpful. But with distributed design and leadership there were sometimes gaps and overlaps in roles and responsibilities. Those involved in the learning events throughout, learnt to operate at different levels at different times and to let go of trying to control some of the design and learning processes and to focus not so much on their own roles but to be adaptive and prepared to make contributions as needed to create an enabling environment for co-production of knowledge processes to emerge. Some of these findings are consistent with those of Pohl et al. [23] who found that co-production of knowledge interferes with conventional research practices, self-conceptions and roles of researchers in a fundamental way and that researchers intuitively adopt different roles to deal with the challenges of co-production. It was found that overall a co-design and distributed design process could recognize and build on these different stakeholdings and position-holdings as long as it was well co-ordinated.

3.4. Tools and Techniques

Use of tools and techniques such as conversation mapping or theme analysis was refined in the process of the face-to-face events. For example, an attempt to cluster emerging themes in one of the interim events was found to be over-complex, leading to some loss of focus about what was felt

important to discuss. Participants' comments about their experiences of this process were listened to and in the following event a simpler, and what was experienced as a more natural process, was used. Groups identified for themselves the questions they wanted to pursue and continued to use these questions over several sessions in whatever ways they wanted, simply reporting to plenary sessions, rather than attempting to direct discussion to points of synthesis. Systems tools and techniques were found to be useful in helping to keep the process focused on systems of relevance to participants. Indeed, all the concepts, tools and techniques shown in Table 1 proved useful for different purposes (e.g., exploring, representing, sharing, communicating and challenging different understandings) and as part of an overall design for co-learning. Some of the techniques were also mutually supportive e.g., when a model or diagram was supported by a presentation and vice versa. Feedback and critical review were particularly important for learning, and setting time aside and allowing agreement processes for these activities through 'contracting' within the group also ensured there was opportunity to check understandings and to notice points and issues that in the multi-language context of the workshop might otherwise have been missed. The notion of trajectory (discussed in Section 2.3.1), proved a useful way of developing a connected sense of past, present and future pathways for change at both individual and group levels and conversation maps were often referred back to later on in the events The idea of a performance (also discussed in Section 2.3.1) was found particularly useful in considering collective and concerted actions.

Continuity of some of the researchers/facilitators enabled a sense of what worked well and less well in encouraging interaction, and by the final event in Italy there were fewer concerns expressed by participants about timing or lack of focus or covering too broad a range of issues. Focussing on trajectories (past, present and future) of water governance provided a useful structure for inquiry both within and across events.

4. Discussion

We reflect now on our process of design for governance learning for water governance transformation, how it was and could usefully be conceptualised, the degree to which the design principles were adhered to and what insights emerged from the process. To re-iterate, the aims of the governance learning work package were to develop an understanding of how co-production of knowledge processes work in practice and how they can be supported, and this paper concentrates on design dimensions rather than on analysing specific learning and knowledge processes and outcomes.

4.1. Conceptualising Governance Learning as an Interactive Co-Production Process

WP4 was designed in response to current theoretical framings of communication and innovation which imply that it is no longer useful to limit our thinking about governance learning to processes of adoption and diffusion of project outcomes [55,56]. Numerous studies have shown that insights developed by research are often not adopted by policy makers and practitioners, and that successful innovations are usually based on an integration of (technological and other) ideas and insights from not only scientists, but also from users, intermediaries and other societal agents [56–59]. Theoretical and applied literature on learning, negotiation, participation and communication provide numerous insights and suggestions on how change processes for adaptation and sustainability can be facilitated and enhanced through governance learning and co-production of knowledge [15,60–66].

WP4 started from a conceptualisation of change and governance learning as an interactive co-production process. What was intended was much more than simply communicating the findings. Rather, co-production of questions and findings were our focus as well as joint learning and reflection on implications, lessons and future outlooks. This called for highly interactive forms of knowledge generation where multiple diverse stakeholders (including researchers) engaged in interactive, transdisciplinary joint knowledge production, dialogue and learning processes, putting what they already knew to effective use and developing new knowledge with others. The idea was that these

processes would support the work of those with potential to effect and influence transformations in European water governance: the change agents.

4.2. Our Process of Design for Learning

The learning process was designed around face to face interaction supported by a web-based learning platform that included discussion forums and blogs. As Westberg and Polk ([21], p. 1) highlighted, in a practice-based approach, "*learning and knowing are seen as situated in social practices, in meaning making processes where the involved participants make sense of what they do and why they do it.*"

We have focussed on design because while much has been written about learning for sustainability and learning for water governance [5,10–19,21–25,28–30,43,48,61–64,67–70] not much of the literature has focused explicitly on what is involved in the associated design processes, particularly in practice rather than conceptually. In CADWAGO, partners in the project had considerable experience of designing learning systems in the contexts of water governance and climate change adaptation through past and ongoing research projects which involved diverse stakeholders from different levels and scales [5,8,16–18,21,24,25,28,43,65]. We were able to draw on this experience and in WP4 worked not just at the level of individual events but at the level of the whole project, also taking into account what the project was a part of for different participants e.g., individuals' systems of interest ranged from emergency response to working across different areas of legislation (such as the EU water framework directive and floods directive) to making improvements in water quality at local and national levels.

Did we achieve what we set out to achieve? The adaptation of the overall CADWAGO project design certainly added to what would otherwise have been achieved as it led to the development of a fourth work package on governance learning that extended the range of research questions addressed and additional events and other activity that focused on learning for transformation of water governance in the context of climate change adaptation. As researchers and co-learners, we developed a highly interactive forum and designed our governance learning work package as a system, with inter-related element evaluating its effectiveness and making adjustments as we worked our way through the project. We saw progression from one 'governance learning' event to the next and learnt about design and support of governance learning in the process. In the events themselves, and subsequently, participants fed back comments on many different kinds of learning that we see as relevant to water governance transformation ranging from developing more systemic understandings of water governance to skills gained in using systems techniques in developing a collaborative activity. Ongoing feedback from participants suggests that at least some of the intended actions identified in the events are taking place (e.g., use of systems approaches continues among some of those who participated in the UK events in their own workshops, and a Ph.D. course in the Baltic region discussed as an action in the final workshop is being taken forward through another project).

Through its approach to governance learning in the project, CADWAGO set out to enact three key design principles (principle 1 on participatory design, principle 2 on building in past lessons and principle 3 on designing an enabling environment for co-production of knowledge to emerge). The design process for the events was participatory in that multiple stakeholders took part in the process though different actors participated in different ways, as already described. There was evidence within the learning events and from the feedback received from participants that multiple perspectives on water governance issues had been appreciated e.g., international, national and local level, policymaking, regulating, researching, land managing, water service providing, waste managing, conservation, sustainability, business and industry perspectives. Several participants had more than one perspective in a particular role and sometimes more than one role.

The lessons of the past were built on through drawing on past experiences of participants and through identifying events, responses and ideas that had previously taken place or emerged e.g., in relation to legislation such as the Water Framework Directive and past floods, droughts or pollution incidents. Drawing on past and ongoing case studies was an important part of this process. Feedback from participants strongly suggests that an enabling environment for co-production of knowledge

to emerge was designed and provided in the course of events. This principle is discussed further in Section 4.4.

4.3. Significance of Our Results

Overall, we find that it is too soon to be able to judge the extent to which our results are directly relevant to climate change adaptation and to judge the impact of CADWAGO, as its very philosophy was to work explicitly in the context of other projects and activities. Therefore, any claims made about what has been learnt that is relevant to water governance transformation would not be due to CADWAGO alone. We have however had and to some extent brought forward in this paper, feedback from individuals from Government ministries, NGOs, farms, advisory bodies, research institutes and universities who took part in the CADWAGO process. In the contexts of sustainability and climate change adaptation, these individuals found the CADWAGO process helpful in thinking through how to work more systemically across levels and boundaries, whether they were organizational, institutional, geographical or cultural.

Our experience has led us to believe that design for learning is important and we recognize that we are not alone in that belief and theoretically we are able to build on understandings of others who have explicated design for learning conceptually. Ison was prompted, by his realisation that the future form of Australia's semi-arid rangelands was more a matter of design and choice than rationalist planning, to consider design as "*an involvement in an activity that has many players and that translates human culture, technology and aspiration into form.*" ([29], p. 260). This meaning of design followed Coyne and Snodgrass [71] and is consistent with CADWAGO's view of design for learning.

Design can be considered a part of the support of learning processes. CADWAGO focussed largely on social learning (as detailed at the end of the description of the Italian event). Woodhill [67] in the context of Australian Landcare, argued that social learning requires conscious design and facilitation and does not just happen by accident. This might appear to be contrary to Wenger's position [31], in relation to communities of practice in many different domains; that learning cannot be controlled or designed but is something that happens, whether it is designed or not. But both have actually focused the design task on what supports learning i.e., not on designing learning per se but on designing for learning. Woodhill focusses on institutional design, including institutions that enable learning and Wenger on the design of social infrastructure that fosters learning. Both saw this kind of design as essential to today's societies and to sustainable development. They, and we, used the 'for' in the notion of design for learning, not in a way that suggests any purposive control of learning but in the way that Sterling ([68], p. 205), uses it in conceptualising "education for change" where he focuses on the role of educational practice in bringing about purposeful change, in a constructive sense where purpose is not imposed.

The design process itself can also be seen as a learning process, contextualising what is being designed and as such consistent with second-order logic. This viewpoint also draws on traditions of design thinking that build on reflective practice which was much influenced by Donald Schön who drew out many assumptions about practitioners and their learning processes and, for instance, distinguished between reflection-in-action and reflection on action [72,73]. In considering what insights were gained from the CADWAGO project's fourth work package we follow and build on the insights of many others (including Ison [29], Wenger [31], Woodhill [67], Coyne and Snodgrass [71], Schön [72], and Franks and Cleaver [1]) to suggest that, from a theoretical point of view, 'design for governance learning' is concerned with involvement in activity that translates human knowing, social technologies and aspiration into form both for and through purposeful and emergent learning that provides insights into new ways for society to organise itself and manage its activities. This call for 'new ways' suggests 'doing things differently' which is consistent with transformation rather than just 'doing things better' which would be more consistent with more incremental change.

In the CADWAGO context participants wanting to: bring together issues from local national and international levels, connect issues of flooding, abstraction and pollution with governance, get out of

some of the 'silo thinking' found in policy and practice and deal with the dynamics of adapting to climate change, could be interpreted in different ways, e.g., as integration or transformation. However, in practice and on the evidence of the project workshops, these changes require breaking out of old ways of thinking and doing, so they are likely to lead to transformation of governance rather than be brought about through incremental change.

4.4. Addressing Challenges of Co-Production of Knowledge

Pohl et al. ([23], p. 267), from their study of four different national-level projects identified three particular challenges in the co-production of knowledge between academic and non-academic communities, namely addressing power relations, interrelating different perspectives on the issues at stake and promoting a previously negotiated orientation towards sustainable development. From the evidence supplied in this paper it is possible to say that the design process did address the second challenge that Pohl and his colleagues identified, that of interrelating different perspectives. The agendas for concerted action that emerged from the Italian learning event drew on local, national and international levels and connected issues e.g., of flooding and water managing with governance. A key outcome was a gradual development of skills in using systems tools and techniques within the workshop contexts among participants who attended more than one event. However, post-project feedback suggested that some found it difficult to introduce and use those tools and techniques in their own situations. This feedback suggests that there is a temporal dimension in interrelating different perspectives on a continuing basis that warrants further investigation as part of a design for governance learning.

A further challenge for the CADWAGO project's governance learning part of the project in the co-production of knowledge was the distribution of design and leadership of events. How the researchers thought about what they were doing was an important factor in rising to this challenge. Overall, those involved in WP4 moved from thinking of what they were doing as working as a community of practice which was apparent in the Swedish learning event, to something that gave more recognition to what Wenger-Trayner and Wenger-Trayner describe as "a landscape of practice, consisting of a complex system of communities of practice and the boundaries between them" ([74], p. 13). Drawing on the idea of a landscape of practice alongside Franks and Cleaver's [1] idea of governance, those involved in WP4 saw governance as the emerging network and complex social landscape of relationships and encounters among different sectors, interests and practices in society. This conceptualisation of governance was more apparent in the later than the earlier learning events. The full nature of the co-production of knowledge processes that took place in CADWAGO's governance learning events lies outside the scope of this paper but is explicated in further papers [52,70].

4.5. A Call for Increased Attention on Design for Learning

Westberg and Polk [21] commented that limited theoretical attention has been given to processes that enable knowledge exchange. We would include design for learning as a part of such processes. In the context of water governance learning, many of the participants in CADWAGO's events commented that, in their experience, a focus on learning processes, a design process that created an enabling environment and use of tools to draw on multiple perspectives was relatively unusual but welcome. Other initiatives such as SLIM (Social Learning for Integrated Management and sustainable use of water at catchment scale) [16] and HarmoniCOP (Harmonising COllaborative Planning) [69] also support social learning and co-learning and some researchers of the project were part of SLIM, allowing the project to build on these experiences. However, the majority of people participating in the events throughout CADWAGO had not been part of these previous co-learning projects and within water governance overall this space for dialogues and shared understanding needs further investment. By engaging with new participants and organisations new networks have been created leading to an increased capacity to support a transformation in water governance. Building on Westberg and Polk's

point we suggest that more attention is needed on design for learning processes, not just theoretically but also methodologically and operationally.

5. Conclusions

The CADWAGO project explicitly set out to design for learning for water governance transformation in the sense of developing elements of social infrastructure such as face-to-face learning events and online media to bring stakeholders from different levels and scales of governance together and to facilitate co-learning to help improve water governance and bring about transformations to more systemic and adaptive governance regimes. This paper provides an overview of how governance learning was conceptualised in CADWAGO as an inter-active co-production of knowledge process, institutionalised through the work package on governance learning. It has shown how the project enacted this conceptualisation through the design for learning across the face-to-face events and online media by using particular concepts, tools and techniques. Throughout this process the project addressed challenges of co-production of knowledge, such as inter-relating diverse perspectives and the distribution of design and leadership of events.

The project's approach of design for learning took place at the level of the whole project as well as for particular elements such as the governance learning events. Three key design principles were used: namely participatory design, building on past lessons, and designing an enabling environment for co-production of knowledge to emerge. These principles were used in ways that were consistent with second-order design for learning where the researchers took account of the contexts of the research and their own perspectives and history rather than taking an objective stance and using a 'blueprint' for design. This is partly evidenced by the distributed design and leadership.

This paper has identified a range of concepts, tools and techniques that were appropriate for framing and enabling governance learning. The governance learning work package had some elements of novelty in combining particular concepts and methods at different stages of the co-production of knowledge processes, including using different kinds of performance (e.g., a traditional water court and a musical concert) combined with the use of systems diagramming and modelling techniques. As such CADWAGO has made a number of contributions in terms of its design for governance learning. This paper makes an evidence-based case for paying more attention to design for learning.

Overall, the CADWAGO governance learning work package contributed to the learning of many of the individuals who participated who worked at different levels and scales. Participants fed back comments on many different kinds of learning, including that they developed potentially transferable skills in using systems tools and techniques that are seen as relevant to supporting transformation in water governance. The work package enabled joint knowledge production, dialogue and learning processes that focused on improving water governance. Elements of social learning also emerged, in terms of collective processes that led to agendas for concerted actions. CADWAGO drew on many past and existing projects and as yet it is not easy to judge the overall impacts of its activities in bringing about required water governance transformations and building adaptive capacity. It became a part of individuals and groups overall learning systems that seem likely to lead to transformations and build capacity for improved water governance in the longer term but further evaluation will be required to understand these learning systems.

Notions of governance and design for governance learning have been developed and extended in this paper through synthesis of relevant ideas and project-related experiences and in ways that might apply beyond the CADWAGO project. We conclude that learning for transformation of water governance in the context of climate adaptation can take many different forms for different individuals and groups. Design in support of learning for water governance transformation at a project level has a key role to play in helping to ensure meaningful dialogue and purposeful learning, as part of individual and group overall governance learning systems.

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